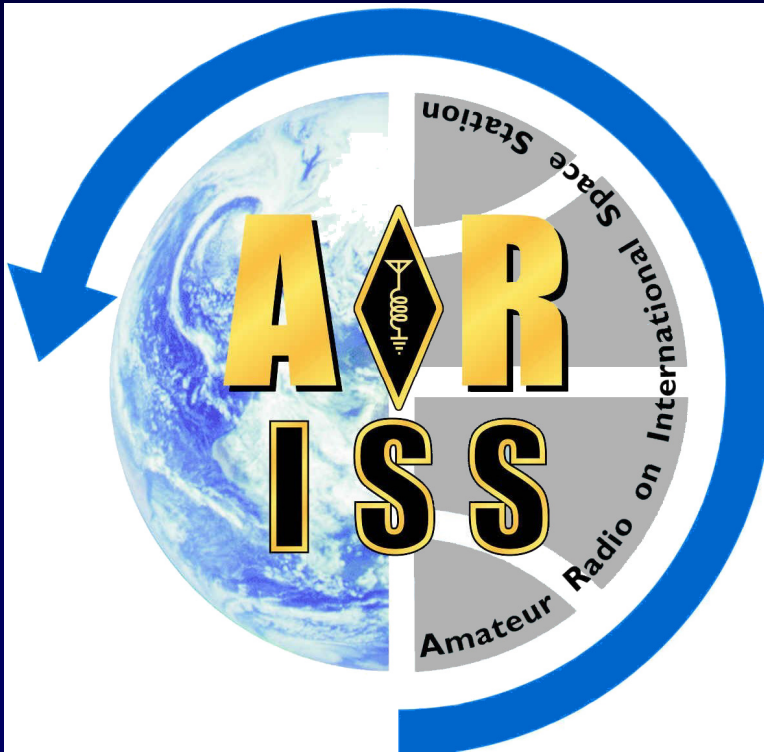


Amateur Radio on the International Space Station (ARISS)



ARISS Development & Operations 2008

Frank H. Bauer, AMSAT ka3hdo@amsat.org

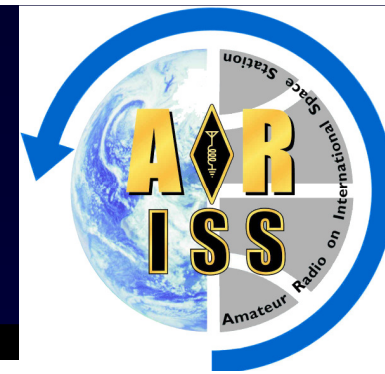


***This Presentation is
Dedicated to the Memory of***

***Dr. Ronald A. Parise,
WA4SIR***

May his exploration spirit continue to live within us all!

Amateur Radio on the International Space Station (ARISS)



What is ARISS?

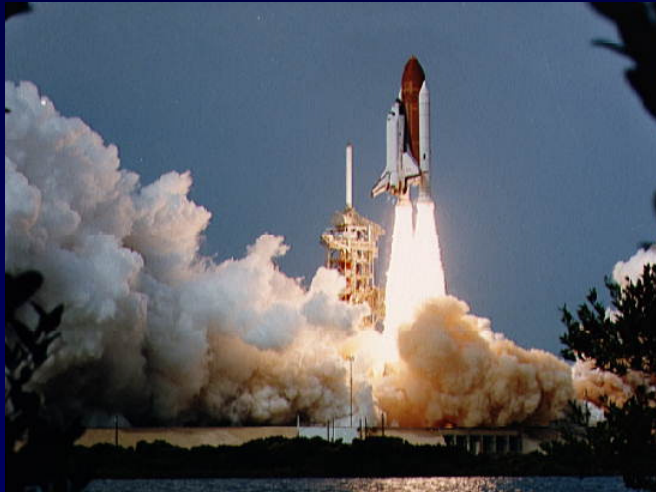
- International program that inspires students, worldwide, to pursue careers in science, engineering and mathematics through communication with the ISS on-orbit crew via amateur radio
- Local community drawn into this once-in-a-lifetime human spaceflight pursuit
- Provides an experiment platform for new telecommunications techniques
- Promotes interest in the amateur radio (ham radio) hobby as a link to better engage students in science and math

ARISS development, operations and student mentoring is performed almost exclusively by a world-wide network of amateur radio volunteers who are passionately committed to the above objectives



Amateur Radio on Human Spaceflight Missions

Since 1983, organizations in the U.S. (SAREX), Germany (SAFEX) and Russia (MIREX), have worked with the space agencies to fly amateur radio and to support Educational Outreach on:



Space Shuttle

ISS



Mir

ARISS Objectives



Spark Student's Interest
In Science & Technology



Crew Family Contacts
(Crew Psychological Ops)



Promote Interest
In Amateur Radio

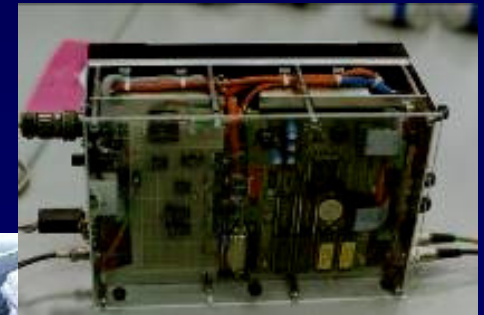


Human Spaceflight
Awareness



Mir SSTV
Dec 12 99 17:29 UTC Rec: WBZCF

Experimentation



Development & Operations on the International Space Station (ISS)

Working with our international partners to develop & operate Amateur Radio on the International Space Station (ARISS)

ARISS Organization

- Nine international partners thus far—Belgium, Canada, France, Germany, Italy, Netherlands, Japan, Russia and United States
- MOU—Formed ARISS to represent the amateur radio community to the ISS Program
- All volunteer organization



USA Sponsors



**National Aeronautics and
Space Administration
(NASA)**



AMSAT

**Radio Amateur Satellite Corporation
(AMSAT-NA)**



**American Radio Relay
League (ARRL)**

On-Orbit Capabilities



**VHF 2-way Voice in the
FGB (Zarya) Module**

**Slow Scan TV
(Picture uplink and
downlink)**



**VHF and UHF Voice in
Service Module
(Zvezda)**



On-Orbit Capabilities

Computer-to- Computer Radio Links

**BBS message posts
and IM-type text
message relay using
packet radio**

Posted : 06/28/97 17:58

To : ALL

From : ROMIR

Subject: Mir Status

We have now got the base block, the module Kvant 2 back on line, leaving 2 more modules. Working very hard, lights in our mouths, in the dark, moving batteries about, to enable better charging, with solar arrays. O2 electrolysis soon, in old Kvant. Much interest from control center to do internal eva to reconnect power to lost Spektr module, to receive its substantial electrical power from its large arrays.

Thanks for all your good wishes. Mike.

CMD(B/H/J/K/KM/L/M/R/S/SR/V/?)>

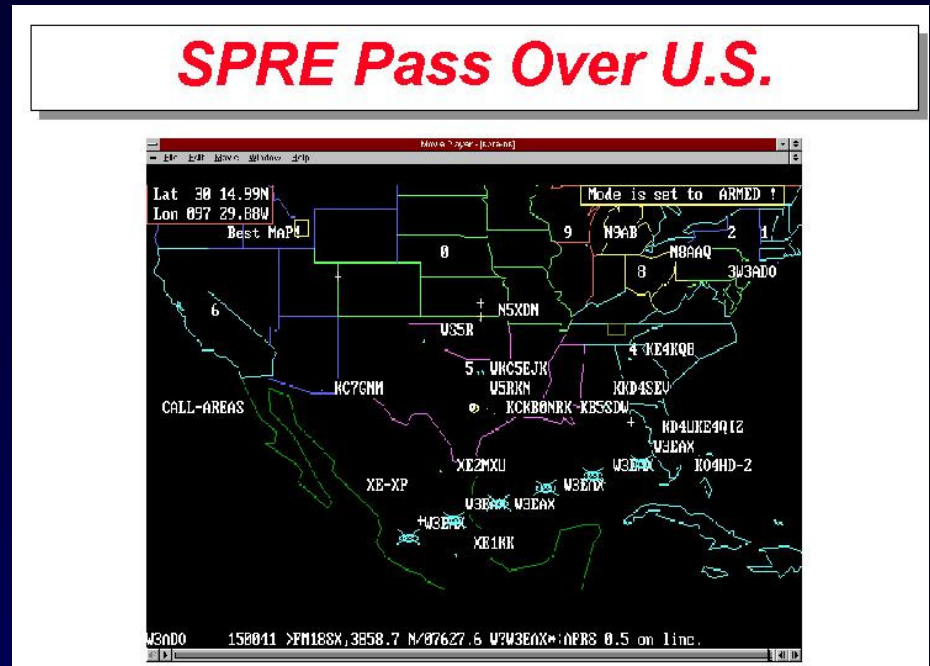
**Amateur Radio BBS message from Mike Foale after
Progress collision with Mir Spektr Module**

Future Capabilities

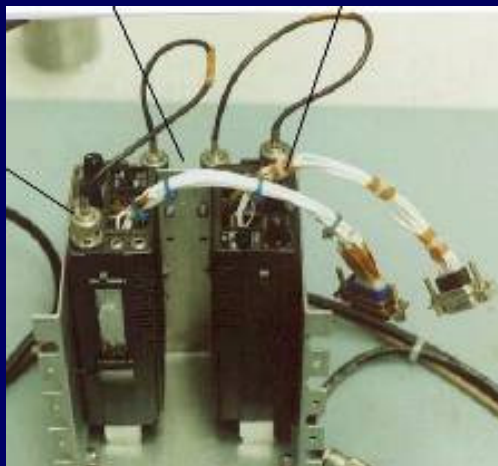


Amateur TV

(Standard, Spread spectrum, & MPEG)



R/T Internet TLM using amateur radio



Express Pallet, External Payloads and Deployed Satellites---w/ student experiments

Examples:
SuitSat-1
Deployment &
SuitSat-2
Development

ARISS Capabilities & Impact

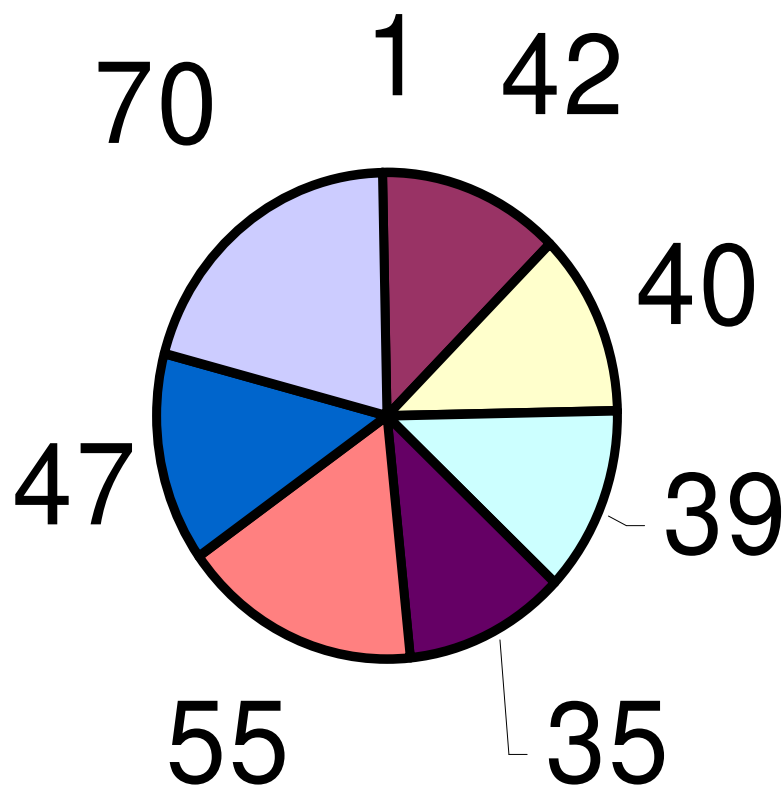
- FGB-mounted 2 m Ericsson radio for voice & packet
 - Operational less than 2 weeks after first crew arrival making **ARISS the first payload on ISS**
- Developed 4 multi-band antenna systems; mounted on the periphery of the Russian service module via 3 EVAs→**2 m, 70 cm, L band, S Band, HF and GPS**
- Developed and installed **2 L/S-band antennas** on European Columbus Module
- Installed UHF/VHF Kenwood D-700E in Service Module near the dinner table and window
- Successful completion of **375** schools—kudos to the international operations team and volunteer mentors on a job well done!
- **17 consecutive ISS expedition crews** used our radio system to conduct thousands of QSOs with hams on the ground since **November 2000**
- Over **15,000** students touched **each year**
- **Millions, worldwide** have heard an ARISS connection
- **Millions, worldwide** see ARISS contact on ISS IMAX film
- Witnessing students, worldwide, become scientists and engineers as a direct result of the ARISS connection
- The first Spacesuit satellite—SuitSat-1/Radioskaf deployed from ISS; **SuitSat-2 on the horizon.**



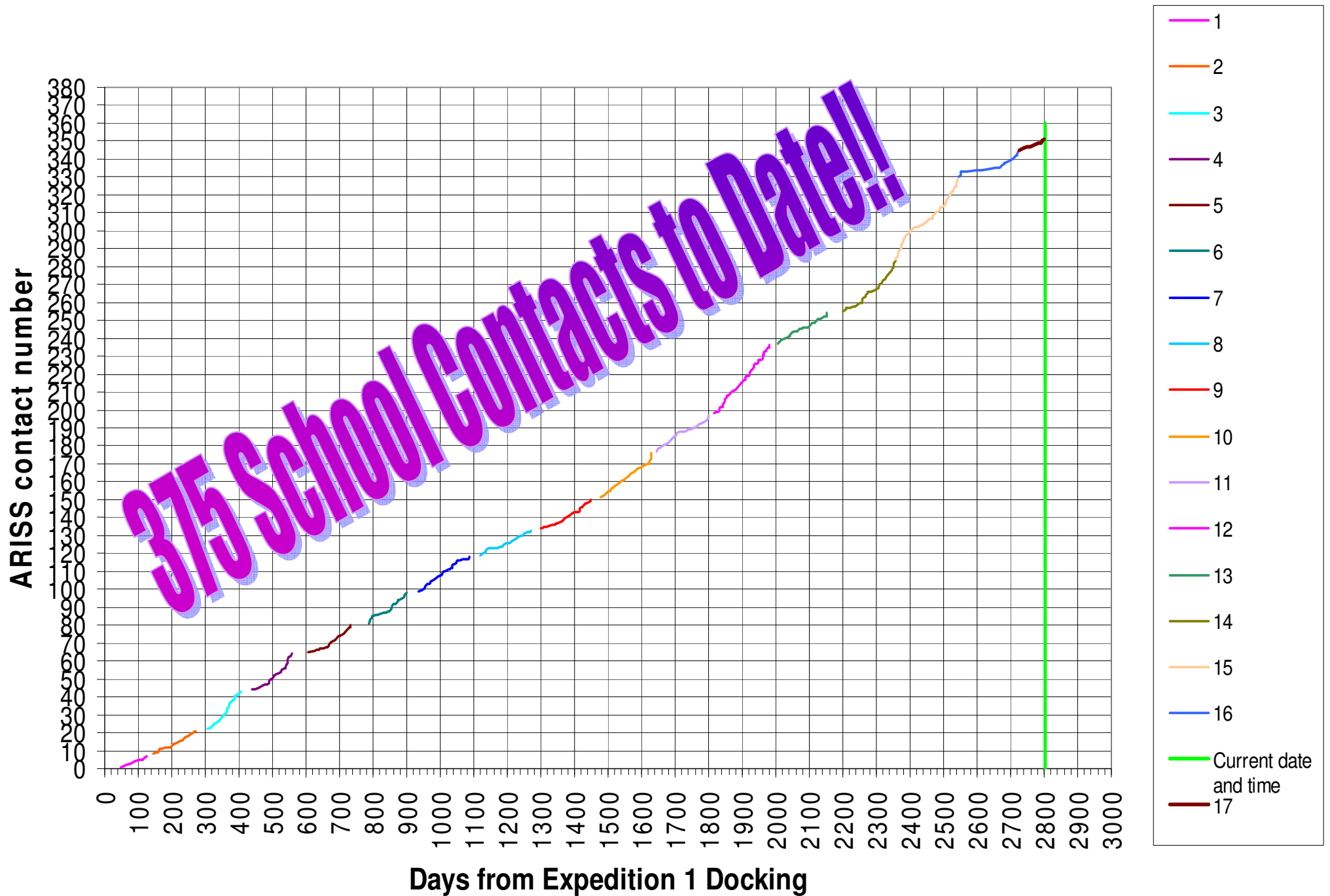
Historic Firsts

- First human tended amateur radio in space (1983)
- First communications between astronauts and people outside official NASA channels (1983)
- First SSTV pictures uplinked and downlinked to Shuttle (1985)
- First astronaut-student interviews (1990)
- First crew contacts with families and friends (1990)
- First computer-to-computer radio links (1990)
- First Television uplink (1991)
- First backup communications during TDRSS outage (1992)
- Most frequent flyer payload in Shuttle Program (25 Flights)
- FGB-mounted 2 m Ericsson radio for voice & packet
 - Operational less than 2 weeks after first crew arrival making **ARISS the first payload on ISS**

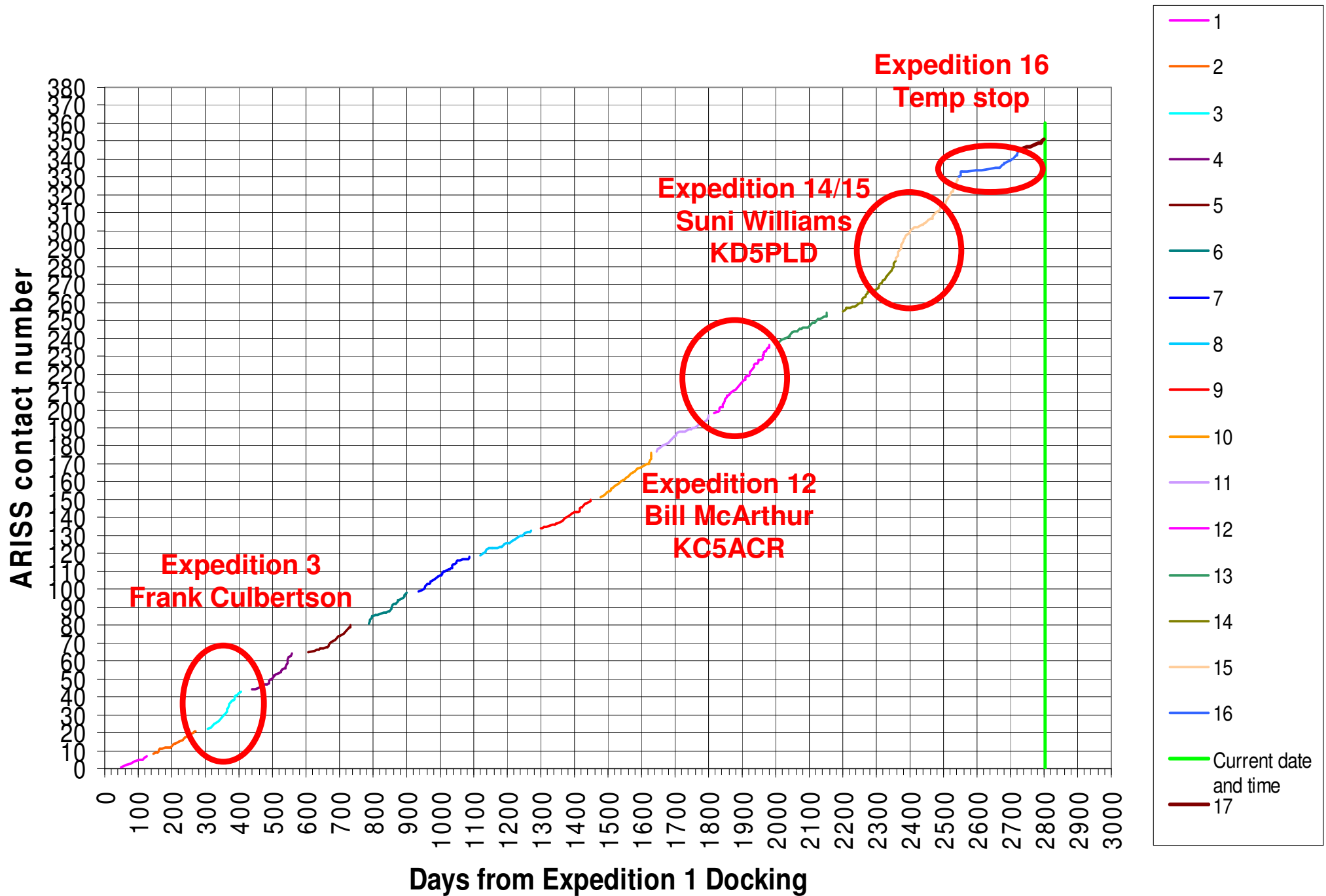
School Contacts Per Year



ARISS Total history running count from Expedition 1 Docking



ARISS Total history running count from Expedition 1 Docking



2008 Space Flight Participant Richard Garriott



Richard Garriott
W5KWQ

Proposed ARISS Activities:

- Earth-view SSTV downlinks—up to 50 Earth views per day
- School contacts—2 Challenger Centers, 2 international and 2 domestic
- Owen Garriott, W5LFL, 25th anniversary commemorative ham contacts
- Support needed: SSTV picture reception (multiple stations), collection & sorting and web distribution

On-Orbit—Oct 12-24, 2008

Richard Garriott Mission Overview

- Richard Garriott, W5KWQ, sixth “spaceflight participant”
- Son of Owen Garriott, W5LFL, STS-9
- Progress-M 65: Upmass of replacement D700, installed before Garriott flight
- Soyuz TMA-13/17S launched on October 12, docked to ISS on the 14th, undocking on 23rd



Where We Are on SSTV

General

- Use of a computer has been problematic, at best, impacting the ability to support the SSTV software solution
 - Sergey Samburov, RV3DR, worked to get a computer delivered on ISS and the flight backup Kenwood D700 & VOX box; the computer is a prime capability for the Space Flight Participants and Backup for ARISS
- Still need to debug the SSTV issues observed on-orbit (constant transmit after image)

Richard Garriott's Flight

- Richard used the computer almost exclusively for high definition Earth Observations, precluding ARISS use of SSTV for bulk of mission
- An SSTV hardware solution was determined to be the best opportunity for Richard's flight; hardware space qualified, delivered to Space Adventures, and flown by Richard on Soyuz

SSTV—Current Capability



**SpaceCam 1/MMSSTV
H/W & S/W**

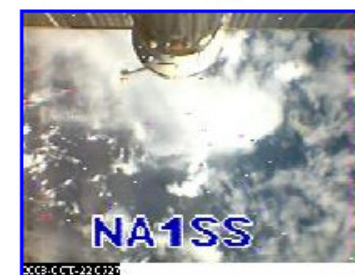


**VC-H1 SSTV
Hardware Solution**



Welcome to the ARISS SSTV gallery

Keep up with ARISS SSTV progress by visiting the [SSTV mission blog](#). Learn more about this project by visiting the [Frequently Asked Questions page](#). You may submit SSTV reception reports by going [here](#). We may not be able to display every image because of quality or duplication but it is important for you to submit them for engineering analysis purposes. You may visit the archive page [here](#).



Submitted by: Go Yeu Bin, 9M6YBG, Oceania
Acquired: 2008-10-22 07:27:00



Submitted by: Carol Szabo, YO3RU, Europe
Acquired: 2008-10-22 11:56:00



Submitted by: Go Yeu Bin, 9M6YBG, Oceania
Acquired: 2008-10-23 06:21:00



Submitted by: BRANKO MARTINCIC, 9A3ST, Europe
Acquired: 2008-10-23 10:40:00



ARISS-SSTV IMAGES

SLOW SCAN TELEVISION (SSTV) IMAGES TRANSMITTED FROM THE
INTERNATIONAL SPACE STATION.

INTRODUCTION

This site will be the focal point for some of the best SSTV images received during Oct 2008 and beyond. Images will be downlinked by ISS on **145.800 MHz**. To submit a received image for possible inclusion in this gallery, go to the following *website* to upload your image.

In addition to SSTV images, notes on planned events for the period of Oct 14-23 and reports of planned amateur radio activity will be provided.

FRIDAY, OCTOBER 24, 2008

Exp. 17 and Garriott land safely

See the NASA release for details at

http://www.nasa.gov/home/hqnews/2008/oct/HQ_o8-269_Expedition_17_landing.html

AT 14:55 

THURSDAY, OCTOBER 23, 2008

Sovuz preparations and landing

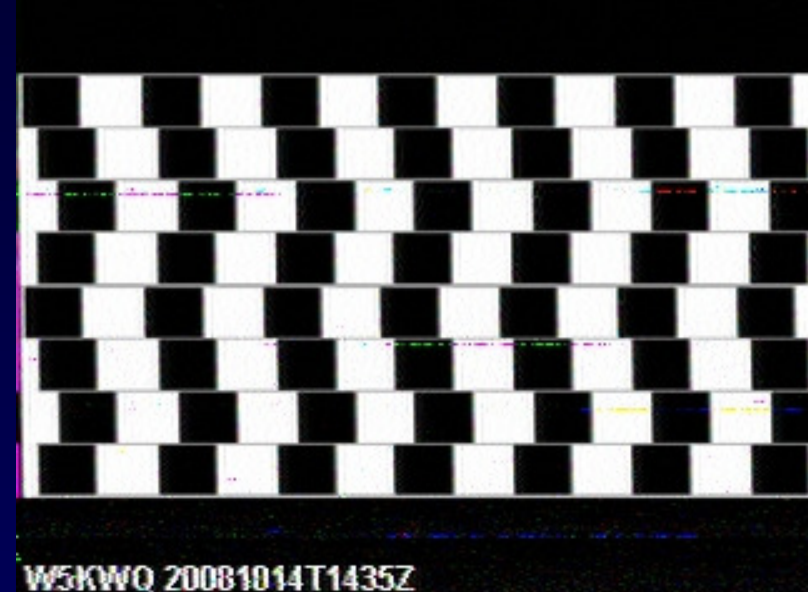


First Images from W4KWQ

October 13, 2008



Greetings From Richard Garriott aboard ISS



Greetings From Richard Garriott aboard ISS







"HAM" in Space

2008-OCT-19 1502



"HAM" in Space

SSTV Example



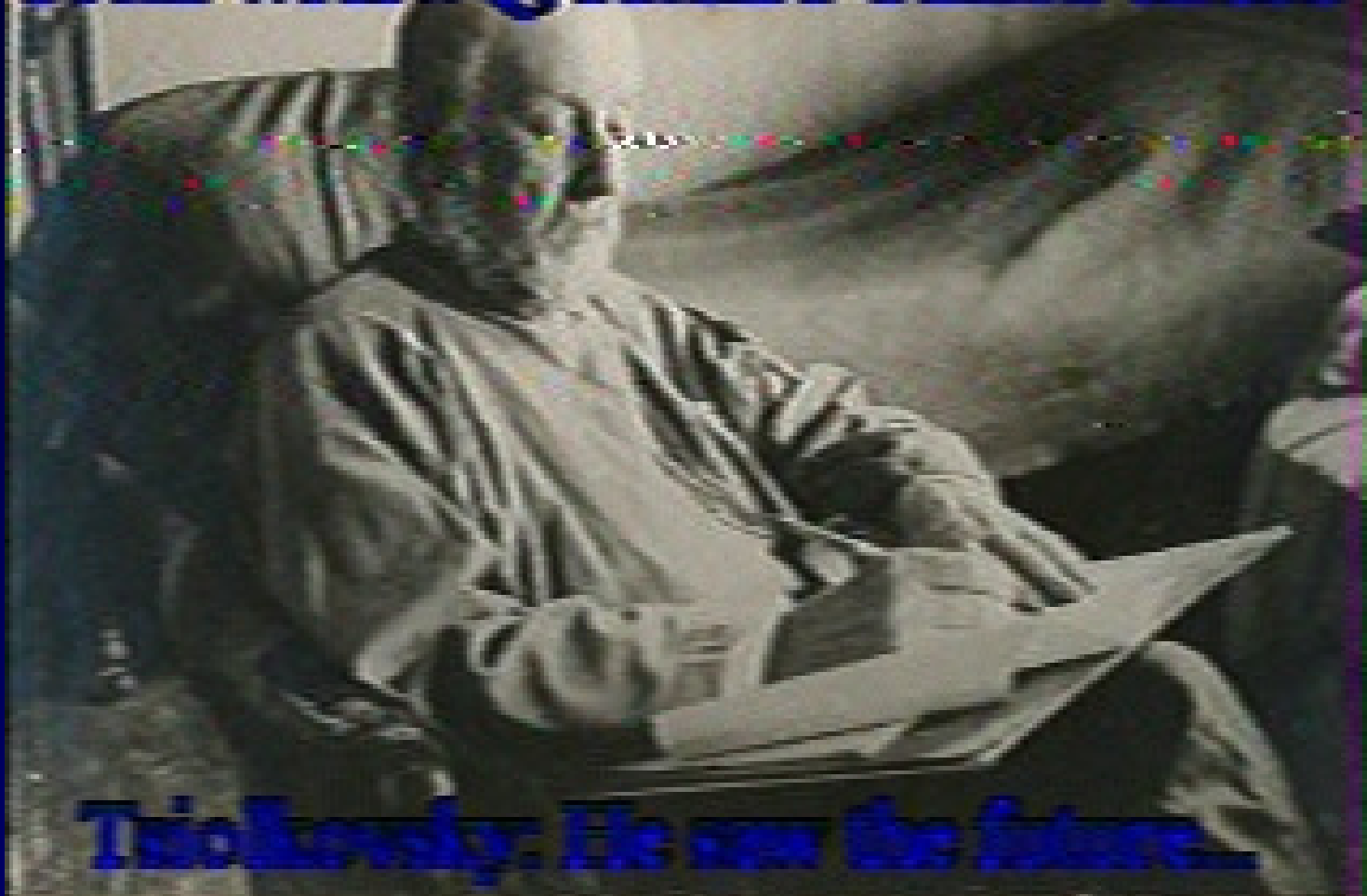
- Submission number: 406
- Name: Tony Messina
- Callsign: KD7TOG
- Email: t-rex@ix.netcom.com
- Continent: NorthAmerica
- Captured: 2008-10-16 15:09:00 UTC
- Original filename: 10-16-08-15.09z.JPG
- Mission: Richard Garriott 1
- Comments: ISS approaching Baja Peninsula Radio: Yaesu FT-8800 Antenna: Arrow J Pole 40' RG58 coax Software: MMSSTV



ISS over Caribbean region
Courtesy: YV6EVC



From WFLWQ, Richard Garrett on 1988



Tricklesky: He saw the future...

OCT-19-2008 1458



OCT-19-2008 1459



2008-OCT-19 1503

Goodbye From Space! - From Richard Garriott

W5KWQ 20081023T1332Z



Goodbye From Space! - From Richard Garriott

N5KWQ 20081023T1221Z



School Contacts

- Two Challenger Center telebridge events:
 - Four schools in one event, three in the other.
 - October 16 & 17 Success!
- Budbrooke School, UK:
 - direct October 17 Success!
- Austin Liberal Arts and Sciences Academy, USA: direct Sun 19th Success!
- Pinehurst School, USA: Success!
- National Space Challenge, Malaysia: Success!

Budbrooke School Contact



Other Events

- Successful Mayor of Austin, TX “friends & family” contact.
- Scouting “Jamboree on the Air”
- Hundreds of voice QSOs.
- SSTV: over 1000 images from VC-H1 and from SpaceCam/MMSSSTV.
- Packet operations at night.
- Austin amateur radio club contacts.

Sample Voice QSO

- I've been trying for a couple of years to make contact with the ISS with no luck. Well, all that changed Tuesday morning as I made contact (by chance) with Richard. He had arrived aboard the ISS just 2 hours prior and I was his very **first contact from space**. And, that was my very first contact with the ISS.

I've been a ham 31 years and can't remember another time that was more exciting. My wife said that my level excitement after the QSO was about on par with that of the birth of our children. Not so sure I'd go that far, but it was definitely an exciting moment.

- In the first part of the QSO, I told Richard that I'd wasted many hours playing Ultima (one of the games he created) 20+ years ago while in school at Auburn University. He said that he hoped that he hadn't disrupted my life too badly. :-)

- Randal DePriest
N4AC
Cumming, GA



Sampling of QSOs, Courtesy of Stan Vandiver, W4SV

17 October 2008 (times approx)	1640Z: ?QRP	21 October 2008 (times approx)	1646Z: VE3DBP
1231Z: WA4SCA (w/ Mike Fincke)	1808Z: VE5G?, VE5EI	1725Z: VA7DG, VE3JJA Woody	1647Z: KD8JAM, K3LTM
1232Z: ? IDI (w/ Mike Fincke)	1809Z: K6EL N California	1726Z: VE5GZ Gary	1648Z: students at K3LTM
1538Z: school QSO in progress	1810Z: VE5CEM Chuck, KC5TER	1733Z: NX1Z	1649Z: W2ET?
1541Z: K8DID Ron	1811Z: N9TAX, NM3M	1734Z: WF1F	
1543: KD8CAO	1812Z: KC5TER Eddie	1900Z: VE5SWL	1818Z: KG7P, k0T
1544Z: K9SM Scotty	1813Z: VE4AMU, KC9MLN	1901Z: VE5CEM	1819Z: K0CQN, VA3P?, VA3ECO, VE3KHQ
1547Z: 13A	1814Z: Richard calls for WF1F	1902Z: VE5MJ, W3XO Bill	1820Z: VE3KHQ (repeat), KA9ERV IN
	1815Z: KA1DLK, WF1F	1903Z: WD0EQP Gene NE	1821Z: KC9NGZ WI
18 October 2008 (times approx)	1816Z: ?PCR, KA1SON Rick MA	1904Z: K9SM Scotty	1822Z: KC9EIZ, K0RJS Ron
1919Z: KC9ELU Mike SE IN	1817Z: N2DY	1906Z: WA4NVM	1823Z: N0UOE
1921Z: KC8RAN Joe Cleveland	2120Z: KL7MF	1907Z: ?XT, N3TL	1824Z: W4CMB
1923Z: WF1F Miles	2121Z: KO9LR	1908Z: N8DDK	1825Z: KS4RX, W5KSI
1924Z: WK	2122Z: AA5PK	1909Z: N5UXT N Orleans	1826Z: VE3IJD Gene, KN4F
1926Z: PSC, NA4PSC?	2123Z: WD4LHD, J7WAN Jeff	1910Z: K5NDX	1827Z: WA1QDP N4WTF W cntrl Florida
	2124Z: KE5ZW, WA5KBH	No recordings on 22 October 2008	
19 October 2008 (times approx)	2125Z: XE3ISS		
1319Z: K5LBJ School QSO in prog		23 October 2008 (times approx)	
1324Z: W2ABG	20 October 2008 (times approx)	1507Z: VE5MJ, VE7MKF, KS7WY	
1325Z: WB9L, WB8OTH Perry	1211Z: W5DZ College Station, New Orleans, K(E)5RTL JoAnne Lafayette	1508Z: K7VK Vick, ?JAM	
1327Z: KA1DLK SW Vermont	1212Z: KI5T	1509Z: KC5, WB9Z Illinois, KE0LX	
1328Z: WY1U	1213Z: AK5V Bob Ft. Worth, N5ZNL Mississippi, NM42	1510Z: AB5XK, KC2FZD	
1329Z: F (fox)	1214Z: N8MH, VKS (VI4KS) TN	1511Z: W8CO, N0MUA	
1632Z: K0KD Perry	1215Z: KI4ZKS	1512Z: W2DPT, VE3TVV	
1633Z: N7RYW Bill	1216Z: N4ISS Al, WA3SWJ DC	1513Z: VA3HM VA3H? Brian VA3HAW	
1634Z: VE4AMU Winnipeg	1217Z: N4ISS	1514Z: KC2PCF, VE3DWI Tony	
1635Z: W9ORW Bob		1515Z: N2MTH, VE1?	
1636Z: ?DID Green Bay fan, N0MUA Dave Kansas		1642Z: W0TUP North Dakota	
1637Z: N8DZM Dan		1643Z: VE4AHZ	
1638Z: WF1F		1644Z: KC9NGZ, N0ORU	
		1645Z: VE4QZ, KD0FCY Rick, K9SM	

ARISS School Contact Summary

Expedition 1-13

ISS Expedition	School Contacts	Additional Contacts Supported	Schools
1	7	Shuttleworth	4
2	14	De Winne	2
3	22	TMA3/TMA2 Duque	2
4	17	Barbara Morgan special ARISS #121	1
5	14		
6	18	Soyuz TMA4/TMA3 Kuipers	2
7	18	Soyuz TMA 5/4 Shargin	2
8	13	Soyuz TMA 6/5 Vittori	3
9	15	Soyuz TMA 7/6 Olsen	3
10	23	Soyuz TMA 8/7 Pontes	1
11	18	Total Contacts	20
12	38	353 International Schools!! Over 15,000 participate per year Millions witness events each year ARISS in Space Station 3D IMAX	
13	15		
Total Contacts	232		



Crew School Contact Statistics

Top 5 expedition school contacts:

- 1) Exp 15—39
- 2) Exp 12—38
- 3) Exp 14—25
- 4) Exp 10—23
- 5) Exp 3—22

Top 5 individual school contact counts for a single tour:

- 1) Bill McArthur – 37—Exp 12
- 2) Suni Williams – 33—Exp 14/15
- 3) Leroy Chiao – 23—Exp 10
- 4) Frank Culbertson – 22—Exp 3
- 5) Clay Anderson – 21—Exp 15/16

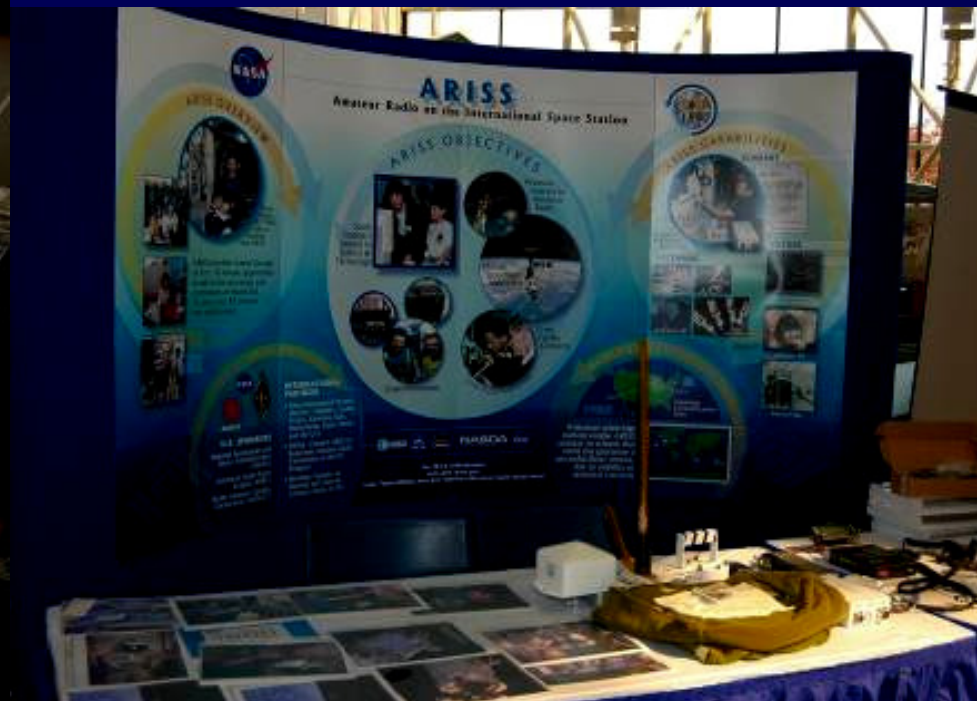


Suni Williams
KD5PLD

Student Contact: Space Day, May 3, 2008 Air & Space Museum



**Astronaut Lee Morin Prepares the Students
for the ARISS Contact**



LAUNCH DATE

CDR

FE-1

FE-2

Current Crew Complement

Exp. 17 Shuttle crew

May 2008
(1J)*

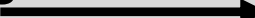
Exp. 18 Soyuz up

October 2008*

Michael Fincke
KE5AIT

Salizhan Sharipov

Greg Chamitoff
KD5PKZ

	LAUNCH DATE	CDR	FE-1	FE-2
Exp. 14/15 Shuttle up	December 2007			Suni Williams KD5PLD
Exp. 15 Soyuz up	April 2007	Fyodor Yurchikhin RN3FI	Oleg Kotov	
Exp. 15 Shuttle up	June 2007 (13A.1)			Clay Anderson KD5PLA
Exp. 16 Soyuz up	October 2007	Peggy Whitson KC5ZTD	Yuri Malenchenko RK3DUP	No Schools  
Exp. 16 Shuttle crew	Oct 2007 (10A)			
Exp. 16 Shuttle crew	Feb 2008 (1E)	School Contacts Resume 		Leopold Eyharts KE5FNO
Exp. 16 Shuttle crew	March 2008 (1J/A)			Garrett Reisman KE5HAE
Exp. 17 Soyuz up	April 2008	Sergei Volkov RU3DIS	Oleg Kononenko RN3DX	
Exp. 17 Shuttle crew	May 2008 (1J)*	You Are Here		Greg Chamitoff KD5PKZ
Exp. 18 Soyuz up	October 2008*	Michael Fincke KE5AIT	Salizhan Sharipov	
Exp. 17 Shuttle crew	Nov 2008 (ULF2)*			Sandy Magnus KE5FYE
Exp. 17 Shuttle crew	Dec 2008 (15A)*			Koichi Wakata KC5ZTA

*** Indicates planning dates. Subject to change**

Mike Finke on ISS—Expedition 18



**Mike Finke, KE5AIT
with the Phase 1 Ericsson Radio**

Expectations:

- Numerous school contacts (up to 2-3 per week)
- Voice QSOs and voice repeater operations
- Re-programming of Kenwood D700
- SSTV operations
- Ericsson radio checkout
- Owen Garriott, W5LFL, 25th anniversary commemorative ham contacts

***Expedition 18 Schedule:
October 2008-April 2009***

Kagawa, Japan ARISS Contact



Flory Academy of Sciences and Technology Moorpark, CA, April 8, 2005



Flory Academy of Sciences and Technology

Moorpark, CA, April 8, 2005



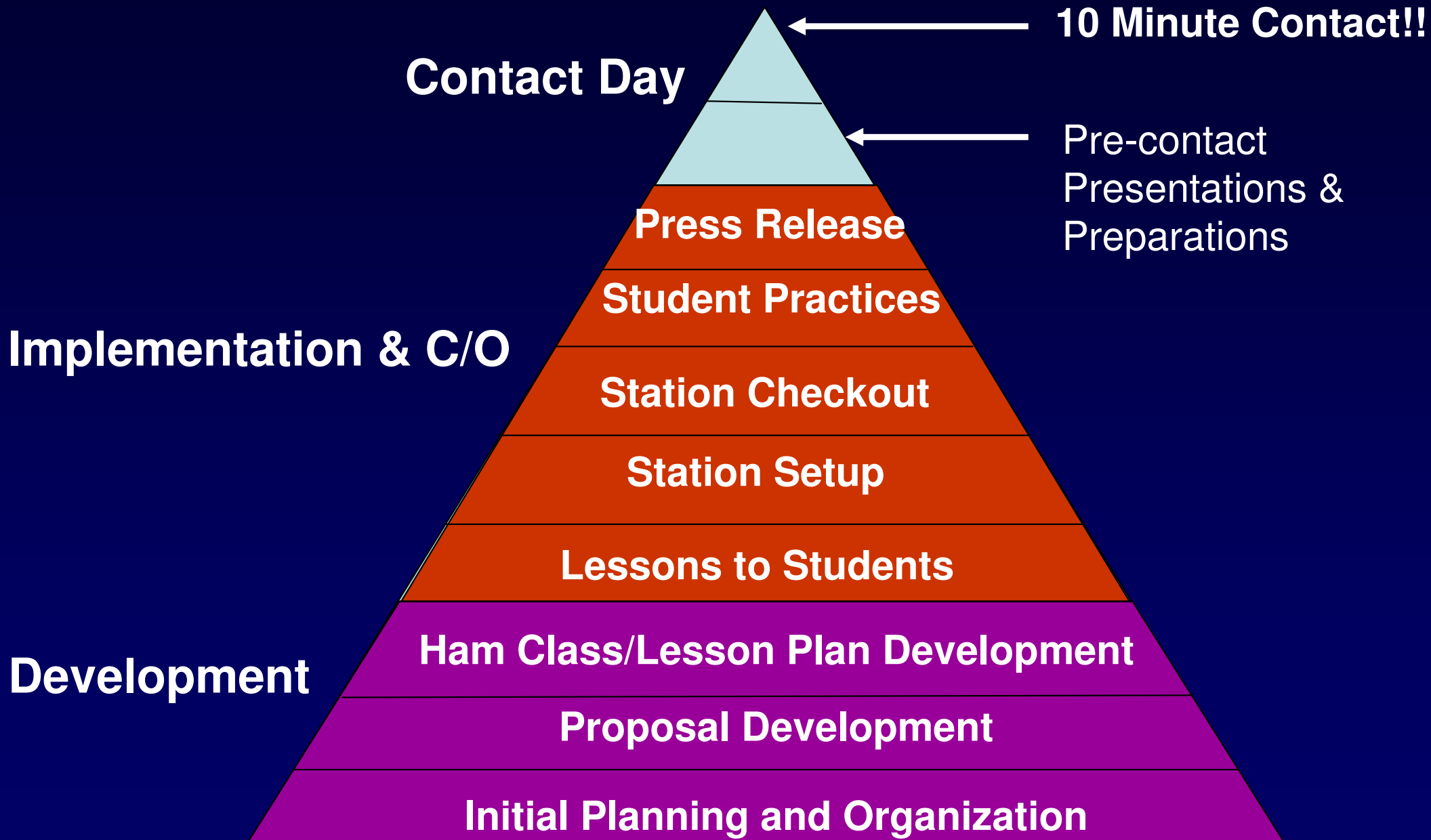
ARISS Contact Commemorating 100th Anniversary of Marconi's USA Transatlantic Contact



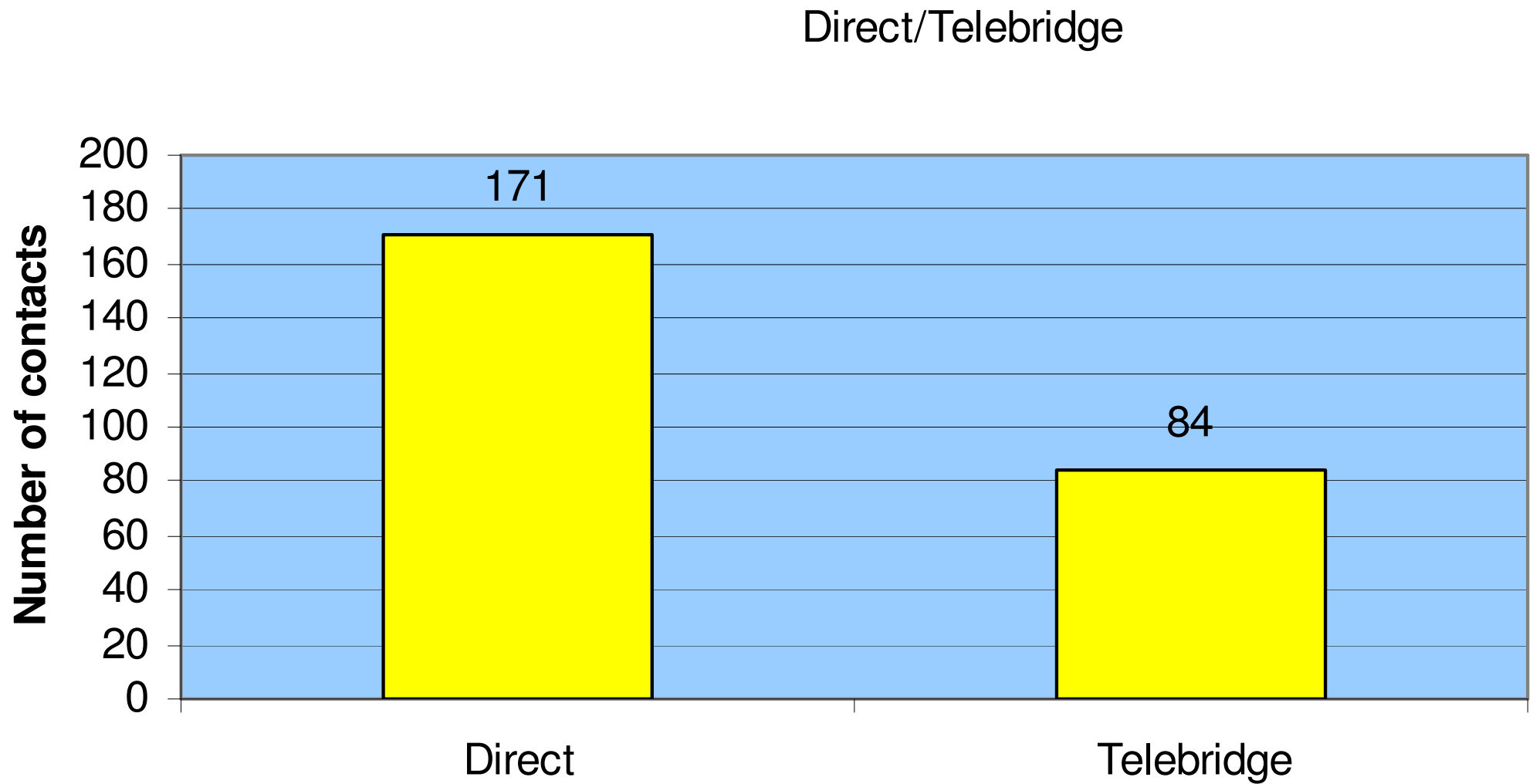
School Contact Considerations

- Scheduling of a suitable contact time through ARISS, taking into account the ground station visibility of the ISS, the crew schedules and the school local time constraints
- The need for an experienced amateur radio team at the school, who mentors the school staff and students and are instrumental in the radio contact between the school station and ISS
- A solid school staff that ensures an effective and comprehensive educational outreach activity

ARISS Preparation Pyramid

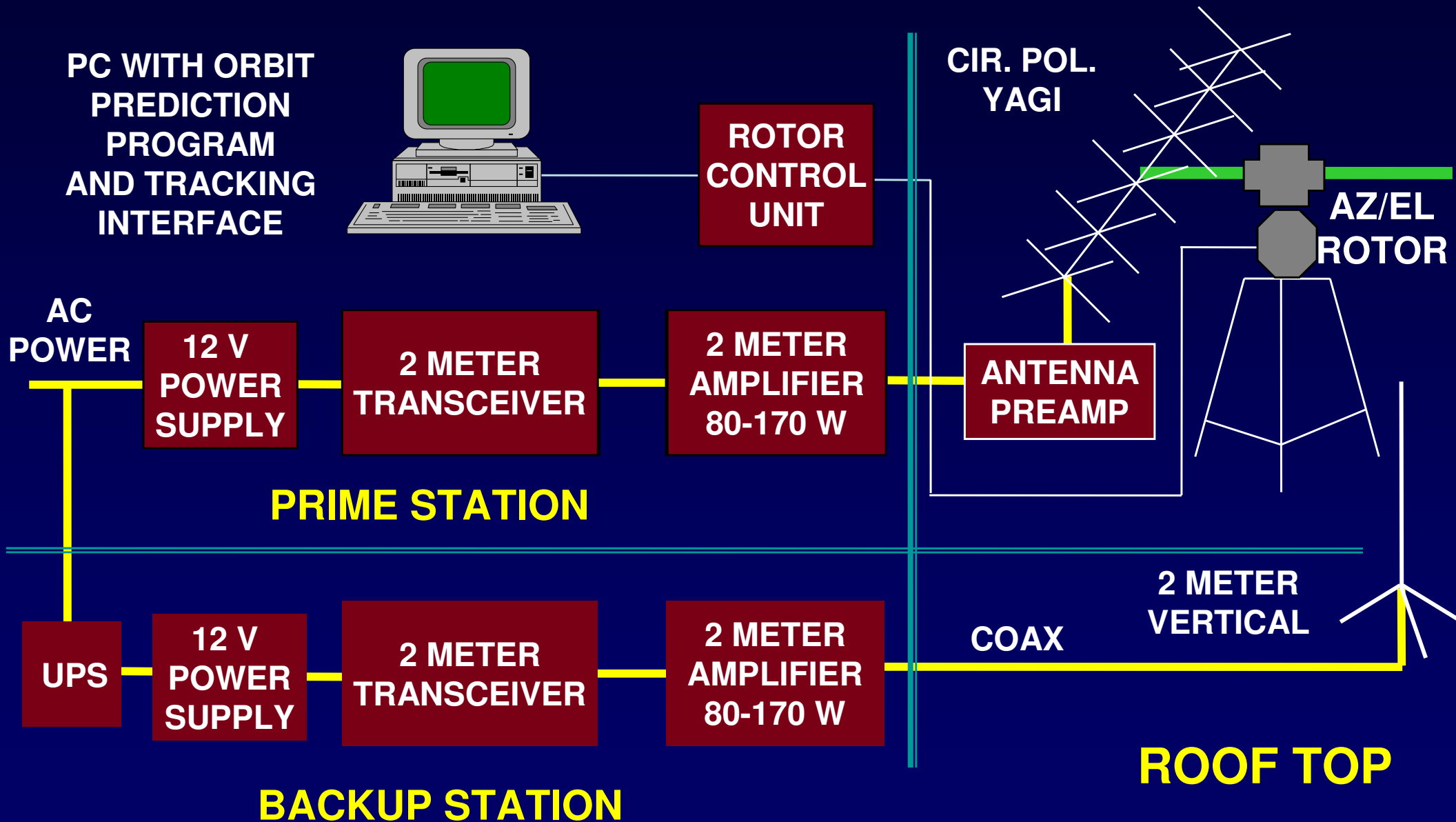


Two Types of School Voice Contacts: Direct and Telebridge

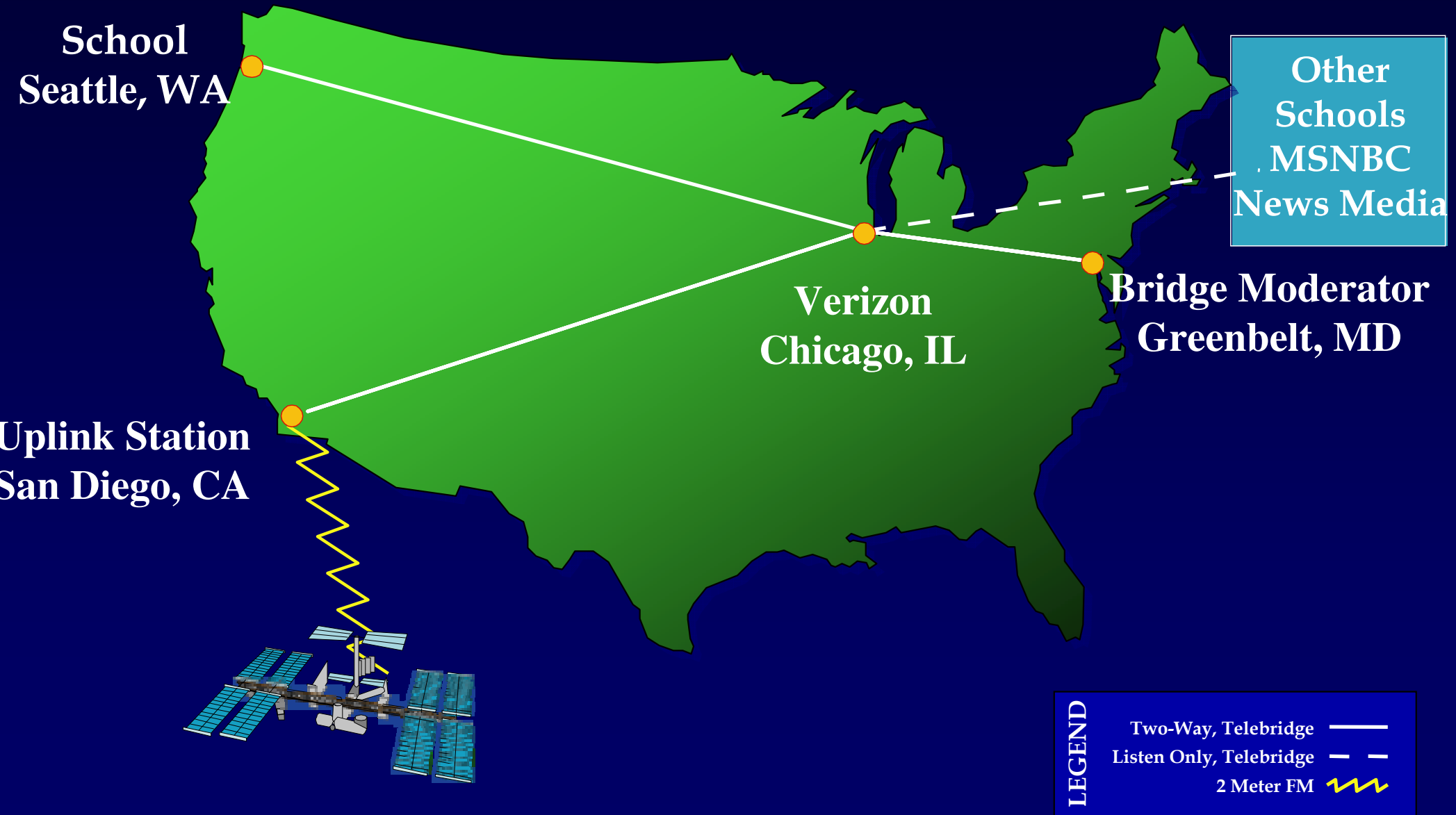


Courtesy: Charlie Sufana, AJ9N

DIRECT CONTACT INSTALLATION

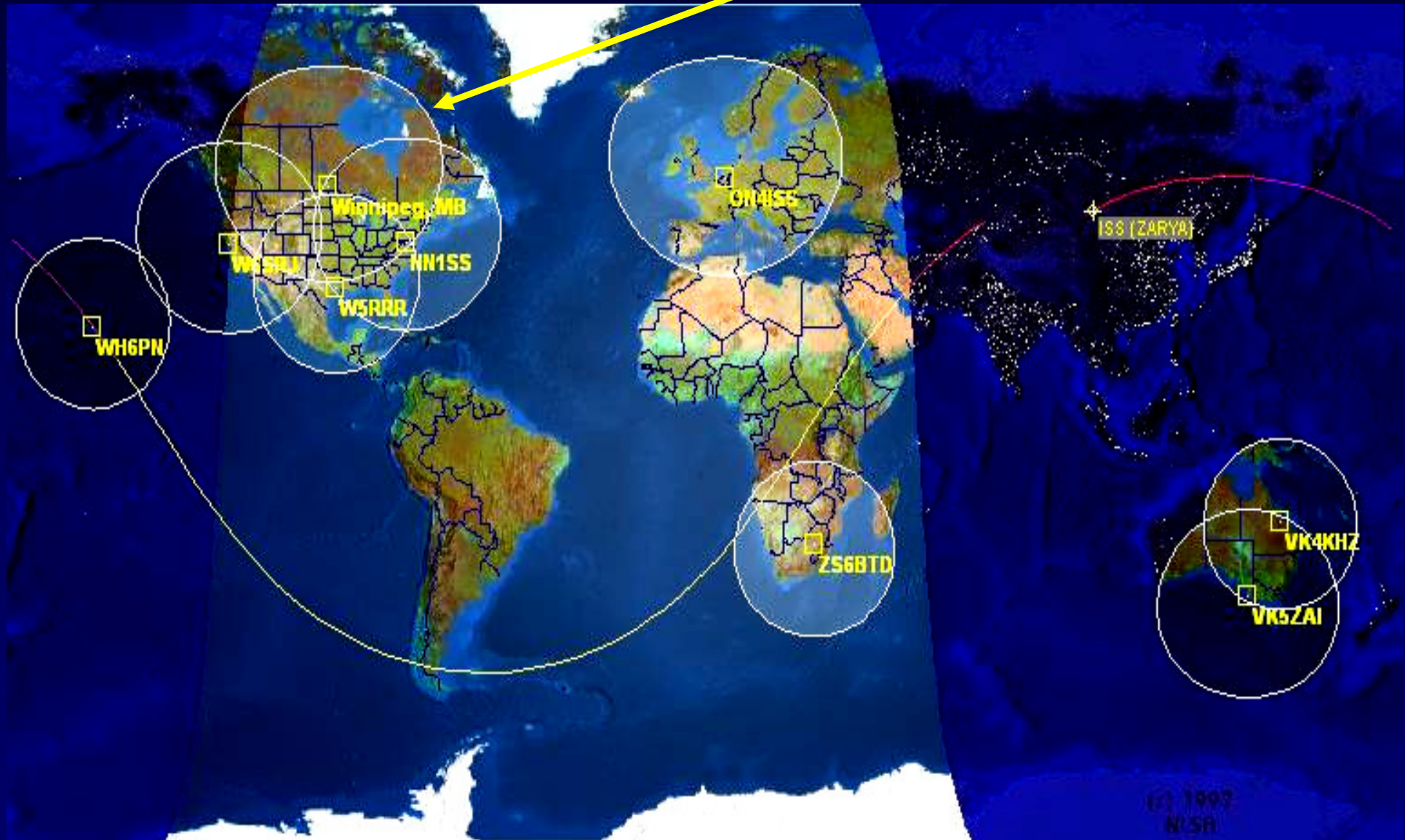


Telebridge Communications Links



Current/Future Telebridge Stations

New VE4NSA Bridge Station



Proposed Augmentation of Bridge Stations (South America and High Latitude)

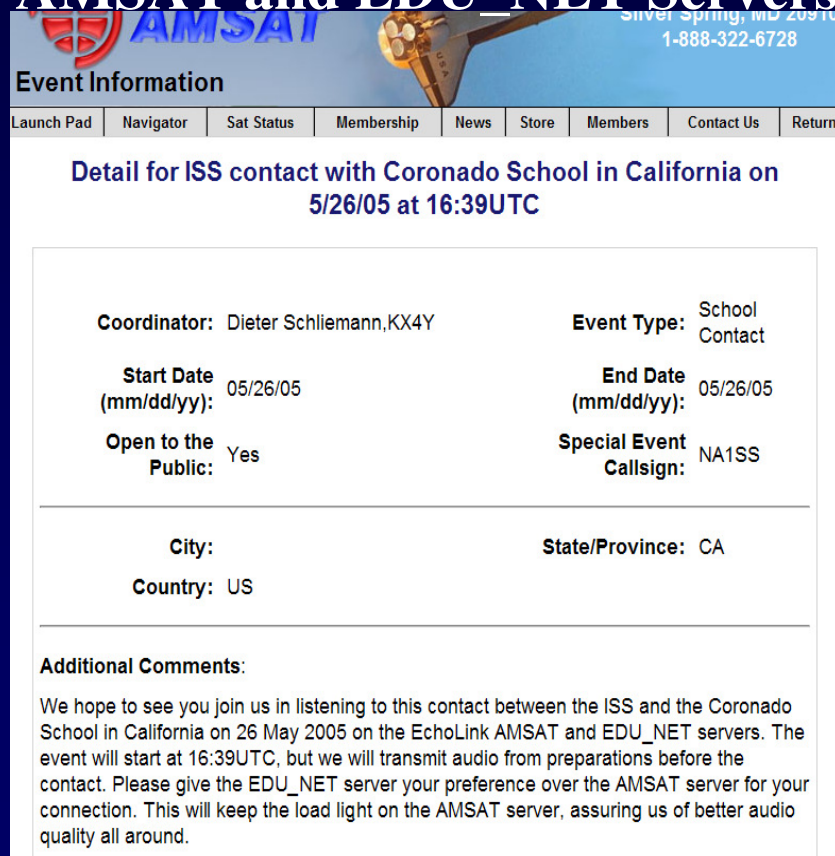


Voice Over Internet Protocol (VOIP)

IRLP, Echolink and Internet Streaming Provides a Wider Reach to Schools and Ham Radio Operators

Echolink

AMSAT and EDU_NET Servers



AMSAT Silver Spring, MD 20910
1-888-322-6728

Event Information

Launch Pad | Navigator | Sat Status | Membership | News | Store | Members | Contact Us | Return

Detail for ISS contact with Coronado School in California on 5/26/05 at 16:39UTC

Coordinator: Dieter Schliemann, KX4Y	Event Type: School Contact
Start Date (mm/dd/yy): 05/26/05	End Date (mm/dd/yy): 05/26/05
Open to the Public: Yes	Special Event Callsign: NA1SS

City: **State/Province:** CA
Country: US

Additional Comments:
We hope to see you join us in listening to this contact between the ISS and the Coronado School in California on 26 May 2005 on the EchoLink AMSAT and EDU_NET servers. The event will start at 16:39UTC, but we will transmit audio from preparations before the contact. Please give the EDU_NET server your preference over the AMSAT server for your connection. This will keep the load light on the AMSAT server, assuring us of better audio quality all around.

www.amsat.org
Calendar of Events

IRLP

9010 "Discovery" Reflector



New Tab | IRLP Reflector 9010 Discovery

Home
News
Events
Sites
Listen
Contacts

IRLP REFLECTOR 9010 DISCOVERY

Thursday, May 26, 2005

Time of connection to Reflector:
1625 UTC (approximately)

Participating School: Coronado Village School

 **Village** Elementary School

Location: Coronado, California, USA

Time of School Contact with ISS:
1639 UTC (approximately)





www.discoveryreflector.ca

Hardware Update

Hardware Development/Ops

Lessons Learned

- ISS is not like Mir→don't expect the same type of ops
 - Differences:
 - Mir crew relied on ham radio equipment to support family contacts, radiograms, air to ground comm
 - Ham radio on Mir was the prime external outlet for the crew
 - ISS communications system much more robust
 - IP Phone on ISS requires very few ARISS family contacts
 - Similarities:
 - Proven educational outreach capability that requires nearly zero setup overhead
 - “Dyed in the wool” hams use the equipment extensively
- After 7 years of continuous operations little crew time for hardware installation, checkout or troubleshooting

Lesson Learned

***Future ARISS Equipment needs to be
Completely Autonomous***

Columbus Module Antenna Installation and Inspection

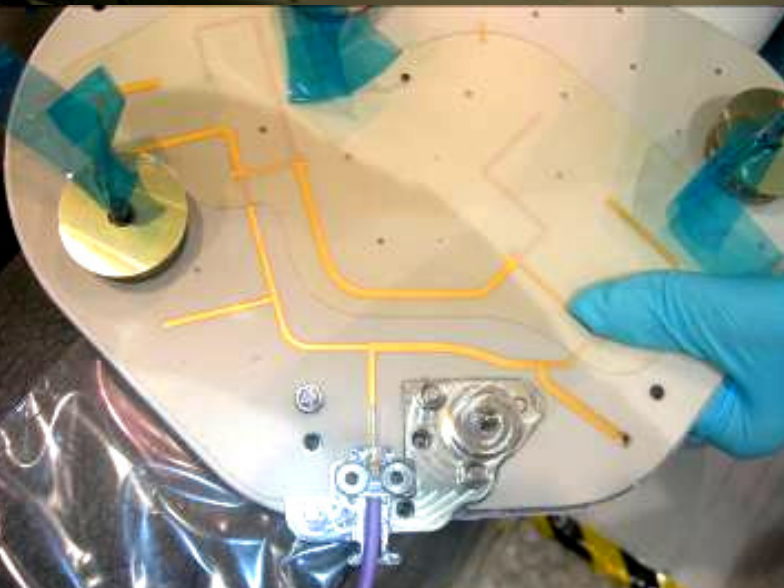
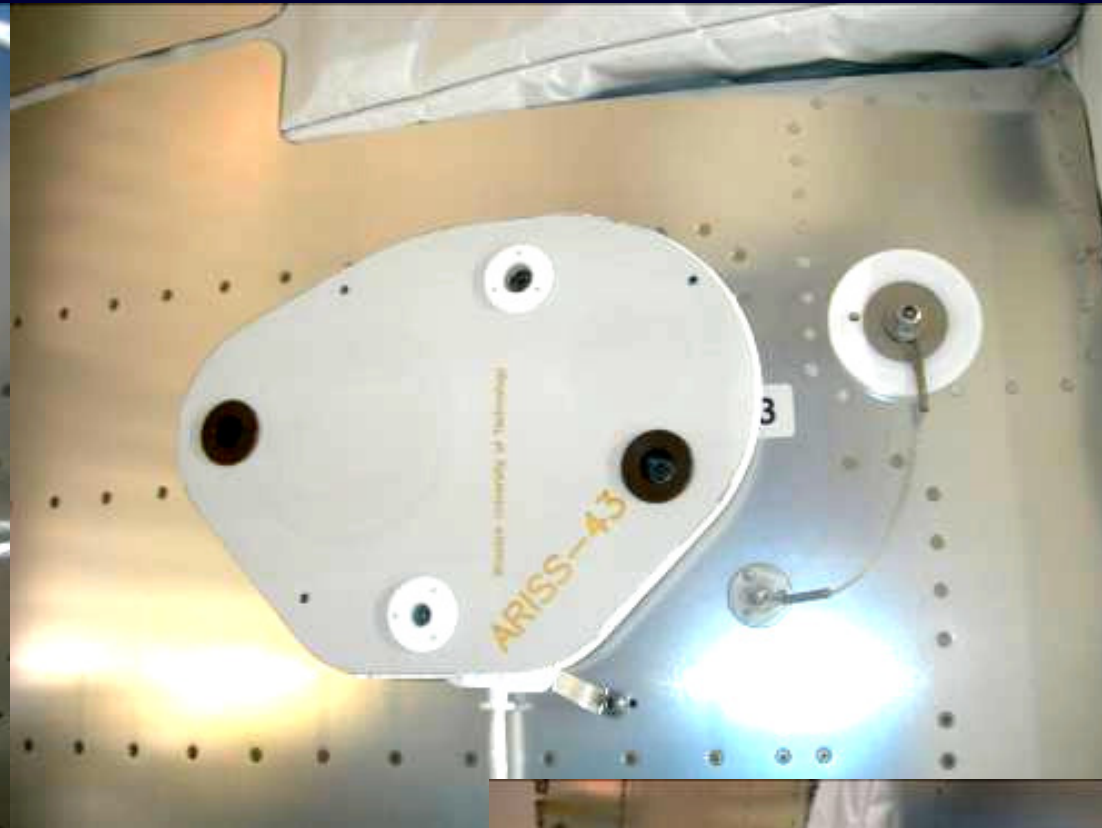
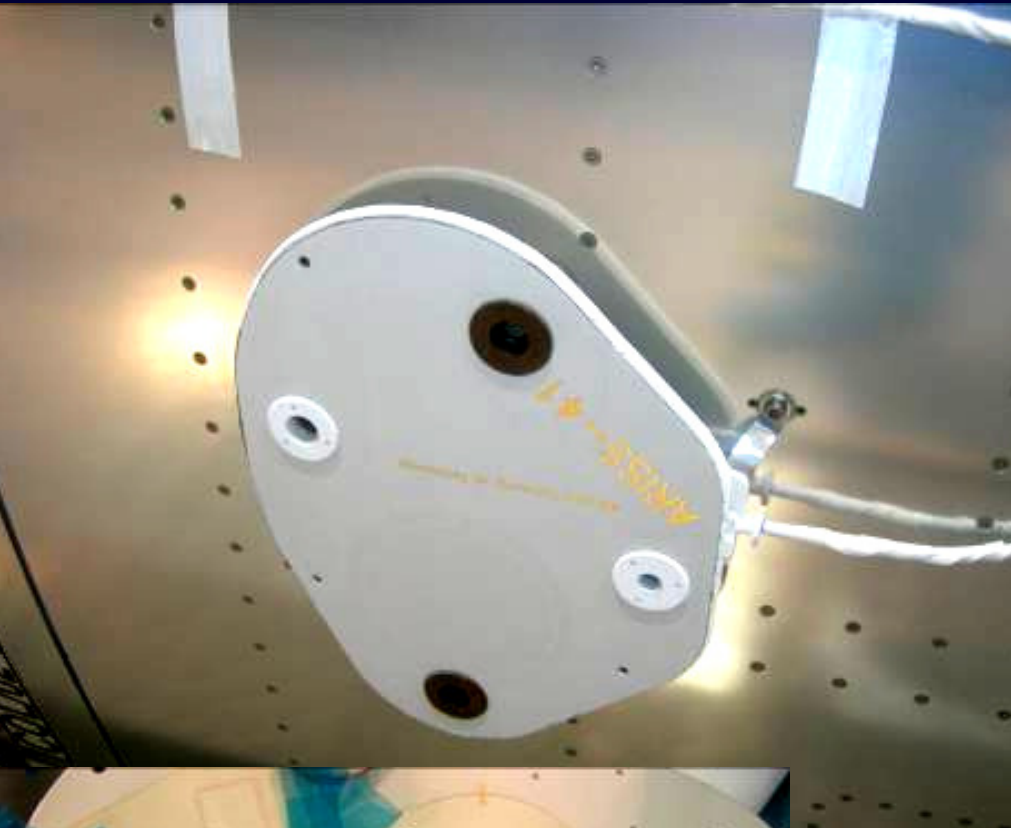


Installation

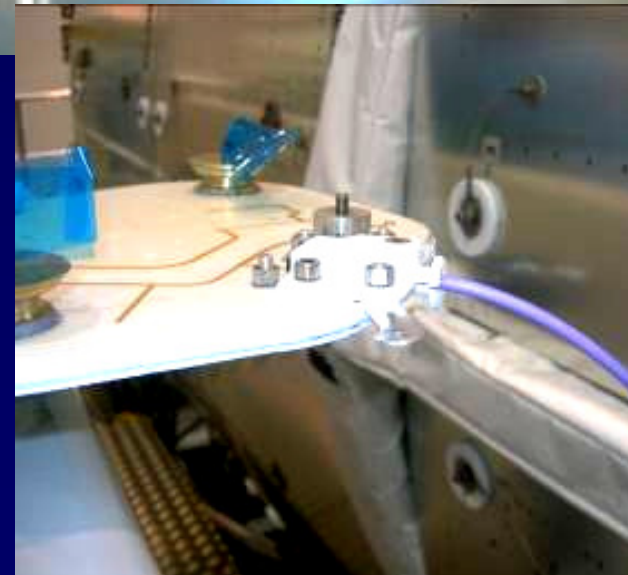


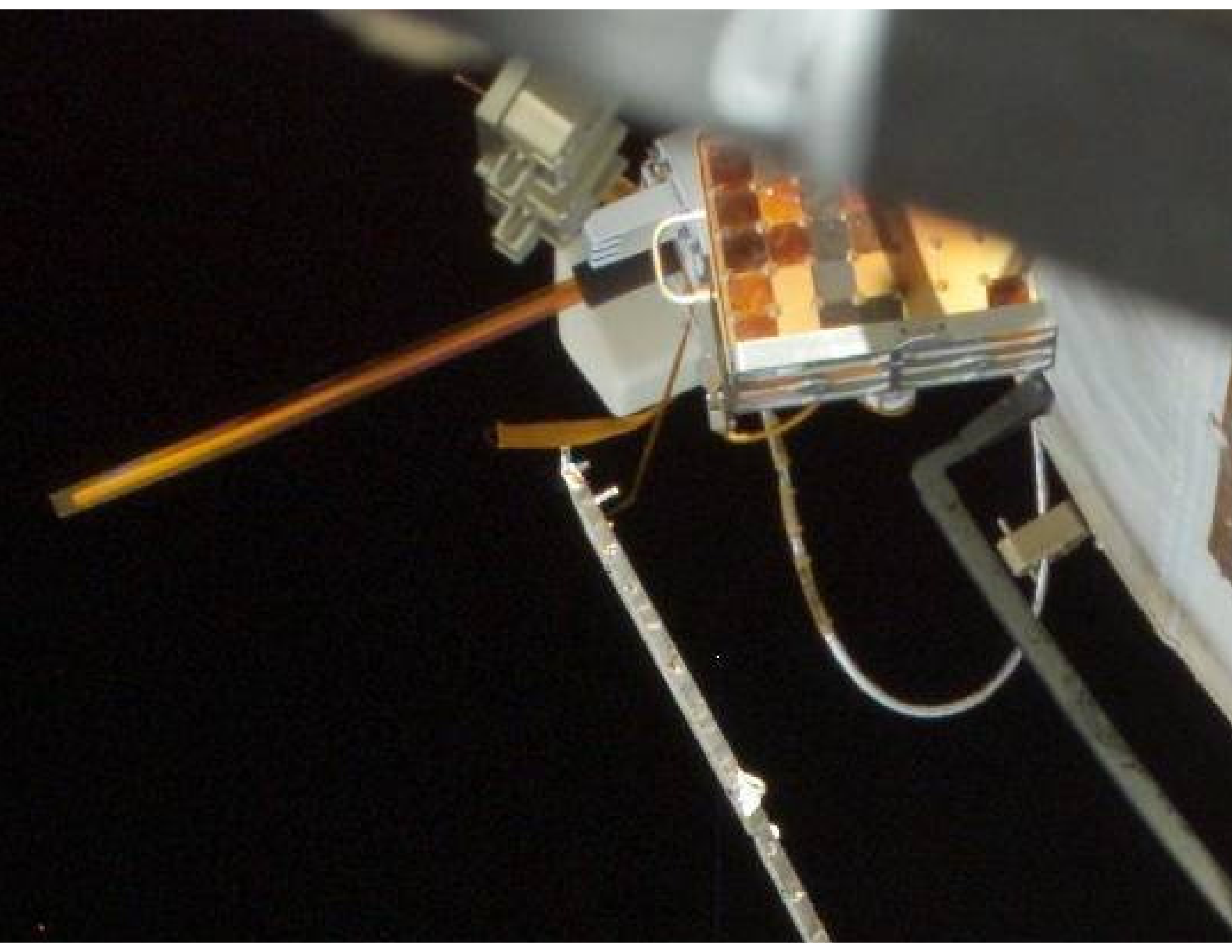
Inspection

Two L/S Band Antennas Installed on European Columbus Module and On-Orbit!!



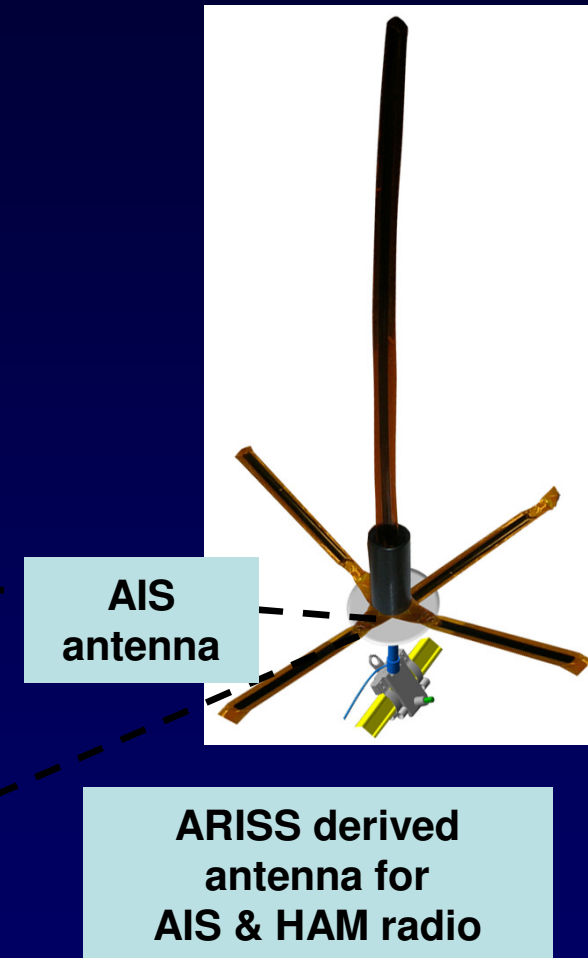
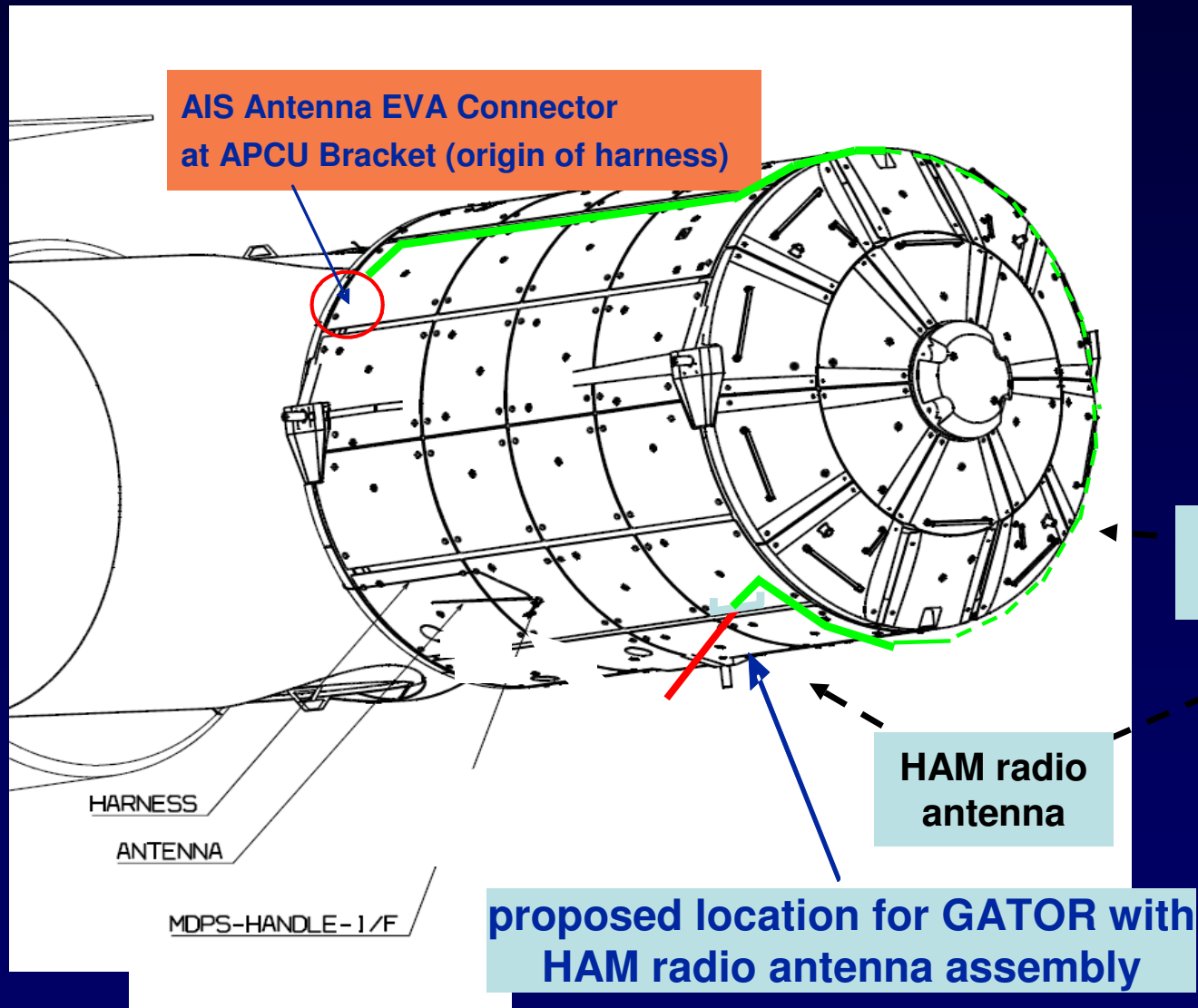
**Launched
February 7, 2008**





VHF/UHF Capability on the Columbus Module

Columbus GATOR EVA Clamp for Installing an ISS Ham Antenna Installation



SuitSat-2 Mission

Primary mission

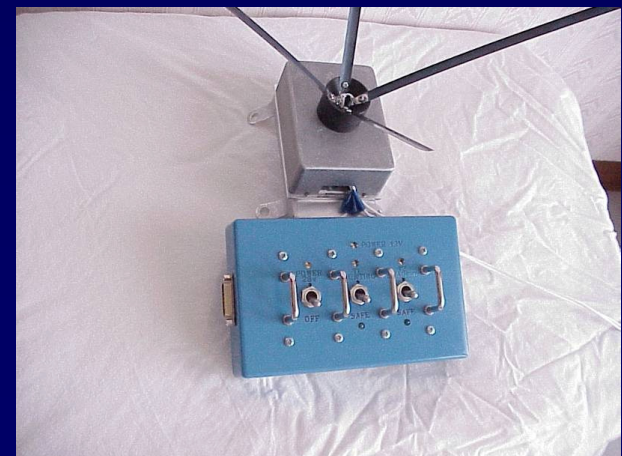
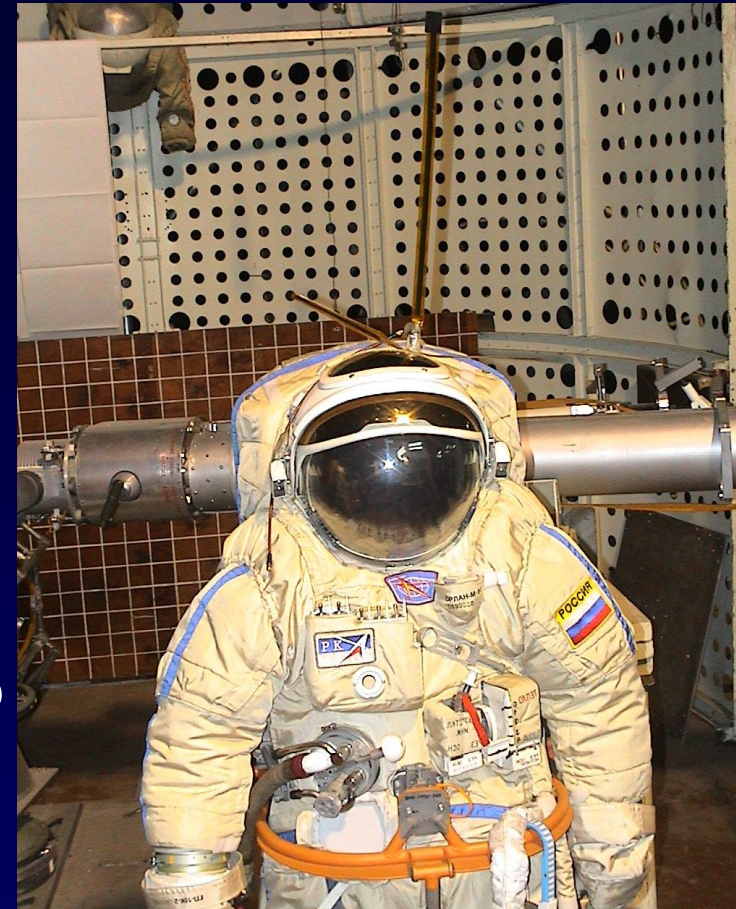
- Voice messages, including student audio greetings from Energia, Mr. Alexandrov, ARISS Europe, ARISS Canada, ARISS USA, ARISS Japan
- A CD/DVD with photos contributed from schools around the world
- School lesson plans for SuitSat-2 educational outreach

Secondary Mission

- Testbed for systems planned for future Amateur radio satellites
- Planned operations
 - CW ID
 - Packet ops
 - SSB Transponder
 - SSTV images of Earth and Station
 - Longer term operation using solar panels

Tertiary Mission

- ARISS and Student Experiments (up to 4)

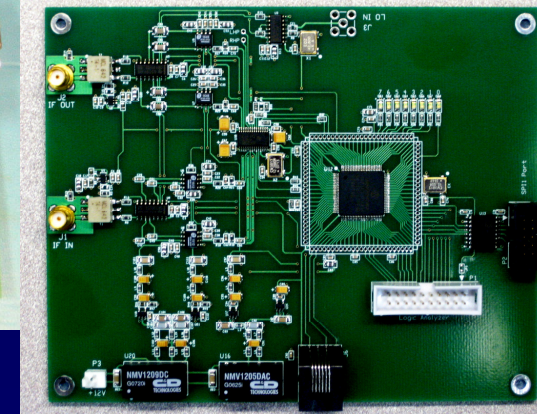
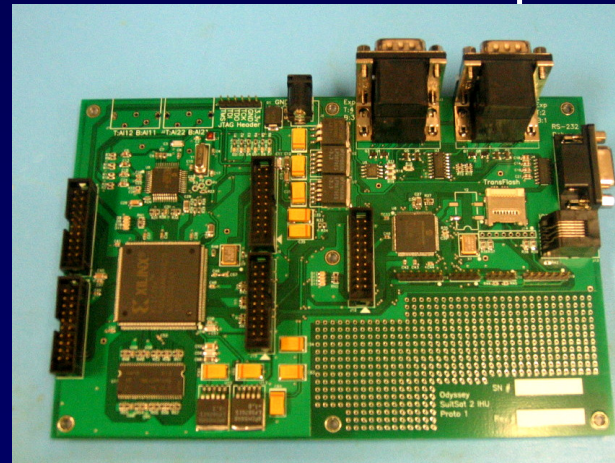
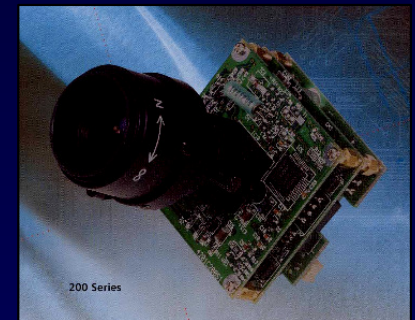


ARISS Phase 3 Hardware Concept



1996 ARISS Phase 3 Concept

- Use SuitSat-2 core hardware to support multi-band autonomous ops
 - Voice
 - Packet
 - SSTV
 - Student Experiments



SuitSat-2 Core Hardware

Future & External ISS Hardware Deployments

- SSTV Ops—Expedition 18
- Phase 2 Yaesu FT-817 Shortwave hardware
- External payload—SuitSat-1—Next activity: **SuitSat-2**



Yaesu FT-817



SuitSat-1



SSTV
Operational!!

General Ham Radio Operations

- Downlink:
 - Worldwide both voice & packet: 145.80
- Uplink:
 - Packet: 145.99
 - Region 1 voice: 145.20
 - Region 2 & 3 voice: 144.49
 - Voice Repeater: 437.80
- Callsigns:
 - DP0ISS
 - RS0ISS
 - NA1SS
 - OR4ISS
- Crew Schedule
 - ~0700 to 1900 UTC
 - Off Saturday Noon to Sunday evening

“QSL” Postcard



The Future

- On January 14, 2004, US President Bush proclaimed a new exploration initiative for NASA---go to the Moon by 2020, Mars next and beyond Mars later
- ARISS team developing Exploration Initiative strategy
- ARISS's solid performance and outstanding international teamwork is recognized and respected by the Space Agencies
- The challenges will be high due to the long path lengths



Conclusions

- Multi-mode, multi operations capability is a reality on ISS
- Payloads provide an outstanding Educational Outreach foundation for ISS
- ARISS's solid performance and outstanding international teamwork is recognized and respected by the Space Agencies
- This is YOUR resource---we look forward to your participation



Frank Culbertson During Scout Jamboree on the Air

Help Needed—ARISS Volunteers

ARISS needs experienced team members to support the following:

- SuitSat Hardware & Software Development
- ARISS Operations Support
- Website Support
- Communications and Public Relations Support
- Educational Outreach

And generalists to support a multitude of tasks

Contact: Frank Bauer, KA3HDO and Mark Steiner, K3MS at their AMSAT e-mail addresses

ARISS Information

<http://www.ariss.org>

New URL!!

